

1 **WHAT IS CLAIMED IS:**

2 1. A plant system for producing a heterologous protein under
3 defined, controlled environmental conditions, the plant system comprising
4 a plant (a) transformed with an expression vector comprising a gene
5 coding for the heterologous protein operably linked to a promoter that is
6 selected for optimal expression under the defined environmental
7 conditions of CEA; (b) that produces a large amount of plant biomass
8 under the defined environmental conditions, and (c) that produces tissue
9 and tissue extract wherein the heterologous protein is stable.

10 2. The plant system of claim 1 wherein the plant is selected
11 from the group consisting of *Solanum*, *Spinacia* and *Brassica*.

12 3. The plant system of claim 1, wherein the plant is *Solanum*,
13 the promoter is light-inducible and the defined environmental conditions of
14 CEA include at least 12 hours of light per day.

15 4. The plant system of claim 1, wherein the promoter is from
16 the ribulose bis-phosphate carboxylase (Rubisco) small subunit gene.

17 5. The plant system of claim 1, wherein the promoter is CO₂-
18 inducible and the defined environmental conditions include between about
19 350 and 2,500 ppm CO₂.

20 6. The plant system of claim 1, wherein the promoter is heat-
21 inducible and the defined environmental conditions include a temperature
22 between about 28 and 40°C.

23 7. The plant system of claim 6, wherein the heat-inducible
24 promoter is the promoter from the hsp80 gene.

- 25 8. The plant system of claim 1, wherein the promoter is a
26 chemically inducible promoter.
- 27 9. The plant system of claim 8, wherein the promoter is
28 from the pathogenesis-related beta 1,3 glucanase
29 gene, lipoxygenase 1 gene or potato proteinase
30 inhibitor I gene.
- 31 10. The plant system of claim 1, wherein the promoter is a
32 dark-inducible promoter.
- 33 11. The plant system of claim 10, wherein the promoter is
34 from the potato proteinase inhibitor I or
35 aminotransferase gene.
- 36 12. The plant system of claim 1, wherein the promoter is a
37 constitutive promoter.
- 38 13. The plant system of claim 12, wherein the promoter is
39 from the tobacco rpl34 gene, the agrobacterium
40 nopaline synthase gene or the CaMV 35S gene.
- 41 14. The plant system of claim 1, wherein the plant is potato
42 which produces between about 0.2 and 5 kilogram fresh weight vines per
43 plant.
- 44 15. The plant system of claim 1, wherein the plant is mustard
45 which produces between about 0.2 and 250 grams dry weight greens per
46 plant.
- 47 16. A method of producing heterologous protein in a transformed
48 plant comprising the steps of:

- 49 a. transforming a plant with an expression vector
50 comprising a gene coding for the heterologous protein
51 operably linked to a promoter that is selected for
52 optimal expression under defined environmental
53 conditions of CEA;
- 54 b. cultivating the plant under the defined environment
55 conditions of CEA; and
- 56 c. extracting the heterologous protein.

57 17. The method of claim 16, wherein the plant is selected from
58 the group consisting of *Solanum*, *Spinacia* and *Brassica*.

59 18. The method of claim 16, wherein the plant is *Solanum*, the
60 promoter is light-inducible and the defined environmental conditions
61 include at least 12 hours of light per day.

62 19. The method of claim 18, wherein the promoter is from the
63 Rubisco small subunit gene.

64 20. The method of claim 16, wherein the promoter is CO₂-
65 inducible and the defined environmental conditions include between about
66 350 and 2,500 ppm CO₂.

67 21. The method of claim 16, wherein the promoter is heat-
68 inducible and the defined environmental conditions include a temperature
69 between about 28 and 40° C.

70 22. The method of claim 21, wherein the heat-inducible promoter is
71 the promoter from the hsp80 gene.

72 23. The method in claim 16, wherein the promoter is chemically
73 inducible.

- 74 24. The method in claim 23, wherein the chemically inducible
75 promoter is from the pathogenesis-related beta 1,3 glucanase gene,
76 lipoxxygenase 1 gene or potato proteinase inhibitor I gene.
- 77 25. The method of claim 16, wherein the promoter is a dark-
78 inducible promoter.
- 79 26. The method of claim 25, wherein the promoter is from the
80 potato proteinase inhibitor I or aminotransferase gene.
- 81 27. The method of claim 16, wherein the promoter is a
82 constitutive promoter.
- 83 28. The method of claim 27, wherein the promoter is from the
84 tobacco rpl34 gene, the agrobacterium nopaline synthase gene or
85 the CaMV 35S gene.
- 86 29. A method of making a plant system for production of a
87 heterologous protein comprising the steps of:
- 88 a. identifying a plant that produces a large amount of
89 plant biomass under controlled environmental
90 conditions, that can be rapidly propagated vegetatively
91 and produces tissues and soluble protein extracts that
92 provide increased stability against proteolysis and
93 other damage to heterologous protein targets;
- 94 b. transforming the plant with an expression vector
95 comprising a gene coding for the heterologous protein
96 operably linked to a promoter that is selected for
97 optimal expression under the defined environmental
98 conditions of CEA; and

99 c. selecting a transformed plant that (i) produces a large
100 amount of the heterologous protein and (ii) the
101 heterologous protein is stable in plant tissues and an
102 extract made from the plant.

103 30. The method of claim 29, wherein the plant is potato and is
104 selected to produce between about 0.2 and 5 kg fresh weight vines per
105 plant.

106 31. The method of claim 29, wherein the plant is mustard and is
107 selected to produce between about 0.2 and 250 grams dry weight greens
108 per plant.

109 32. The method of claim 29, wherein the plant is potato and is
110 selected to produce between about 10 and 1300 kg heterologous
111 protein/acre/year.

112 33. The method of claim 29, wherein the plant is mustard and is
113 selected to produce between about 8 and 1000 kg heterologous
114 protein/acre/year.

115 34. The method of claim 29, wherein the plant is *Solanum*, the
116 promoter is light-inducible and the defined environmental conditions
117 include at least 12 hours of light per day.

118 35. The method of claim 34, wherein the promoter is from the
119 ribulose bis-phosphate carboxylase (Rubisco) small subunit gene.

120 36. The method of claim 29, wherein the promoter is CO₂-
121 inducible and the defined environmental conditions include between 350
122 and 2,500 ppm CO₂.

- 123 37. The method of claim 29, wherein the promoter is heat-
124 inducible and the defined environmental conditions include a
125 temperature between about 28 to 40°C.
- 126 38. The method of claim 37, wherein the heat-inducible promoter is
127 the promoter from the hsp80 gene.
- 128 39. The method of claim 29, wherein the promoter is a chemically
129 inducible promoter.
- 130 40. The method of claim 39, wherein the promoter is from the
131 pathogenesis-related beta 1,3 glucanase gene, lipoyxygenase 1 gene
132 or potato proteinase inhibitor gene..
- 133 41. The method of claim 29, wherein the promoter is a dark-
134 inducible promoter.
- 135 42. The method of claim 41, wherein the promoter is from the
136 potato proteinase inhibitor I or aminotransferase gene.
- 137 43. The method of claim 29, wherein the promoter is a
138 constitutive promoter.
- 139 44. The method of claim 43, wherein the promoter is from the
140 tobacco rpl34 gene, the agrobacterium nopaline synthase gene or
141 the CaMV 35S gene.